Web Interfaces for Earthquake and Ground Motion Simulation Visualisation

QuakeCoRE
NZ Centre for Earthquake Resilience
Te Hiranga Rū

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Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

1. Introduction

This poster presents two recently deployed web interfaces for data visualisation associated with New Zealand earthquakes, consequent ground motions, and geotechnical conditions.

NZ Vs30 model viewer (https://vs30.seistech.nz) allows users to visualise and query Vs30 estimates for Geology, Terrain and combined models for a specified location as well as geology and terrain categories. This gives an improved visibility about how a Vs30 is chosen making it easy to verify the value intuitively and also identify areas for improving such models for regional applications.

Simulation Atlas (http://atlas.seistech.nz) provides a map-based visualisation of the historically-observed and potential future earthquakes on major known faults in New Zealand and key information about them, such as tectonic type, anticipated magnitude of a potential rupture, and probability in 50 years. For selected faults (108 at present), it provides the 3D animation of the potential ground motion produced by GMSimViz, an in-house-developed automation tool that converts the ground motion simulation output into a 3D animation.

2. NZ Vs30 model viewer: https://vs30.seistech.nz

NZ Vs30 model viewer allows users to visualise and query Vs30 estimates for a location in New Zealand. The estimated Vs30 values for Geology, Terrain and combined models are all provided as well as the geology and terrain categories for the location.

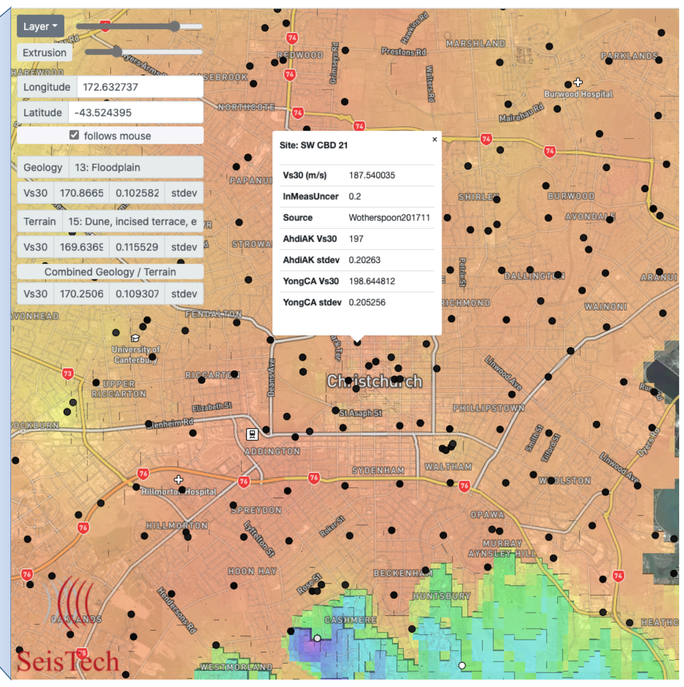
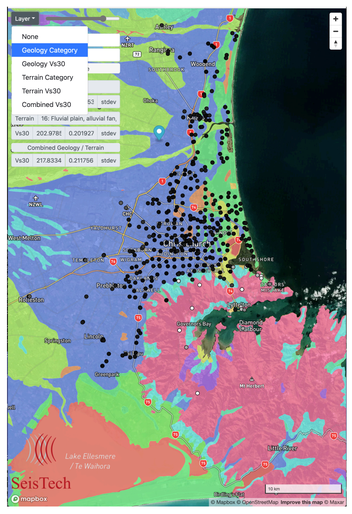
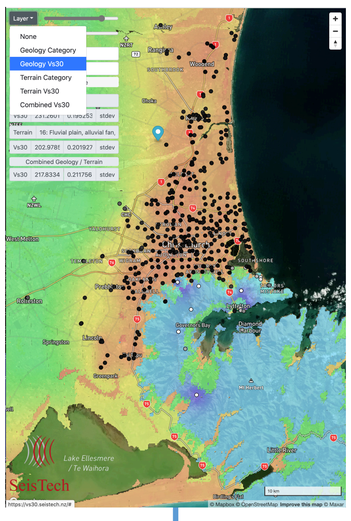


Figure 1. NZ Vs30 model viewer and magnified view of a location at Christchurch CBD. Detailed view for the site indicates that the chosen Vs30 is based on Wotherspoon 201711. Alternative measurements based on other studies such as AhdAK and YongCA are also provided to help intuitive verification of the estimation.

This improved visibility about how a Vs30 value is estimated makes it easy to verify and improve the currently accepted estimation.



(a). Geology Category

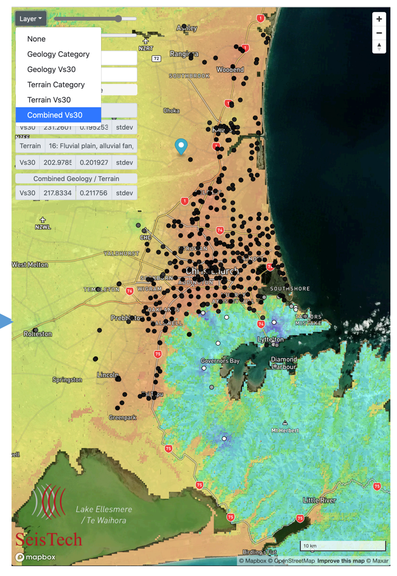


(b). Geology Vs30

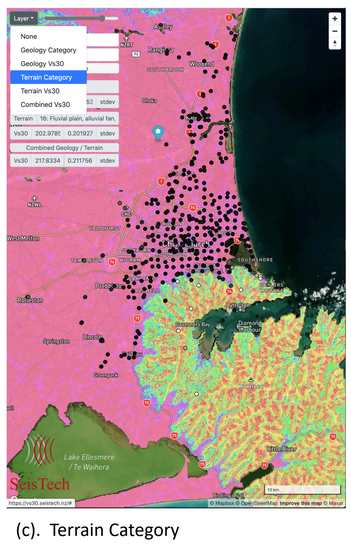
Users can choose one of six layers (None is a plain satellite view), and control its opacity.

Each layer groups the areas sharing the same category or Vs30 estimates and displays groups in separate colours.

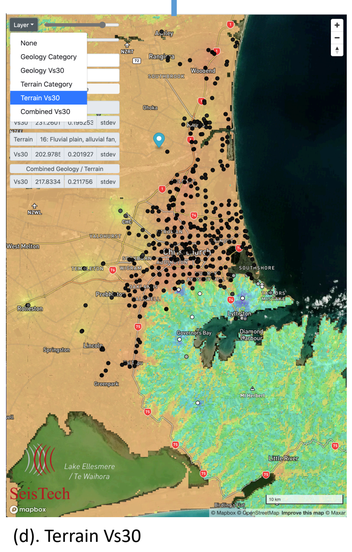
combine



(e) Combined Vs30



(c). Terrain Category



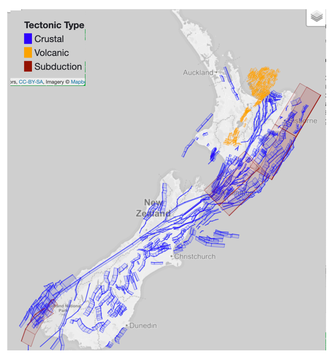
(d). Terrain Vs30

Figure 2. Five layers augmenting plain satellite view (None)

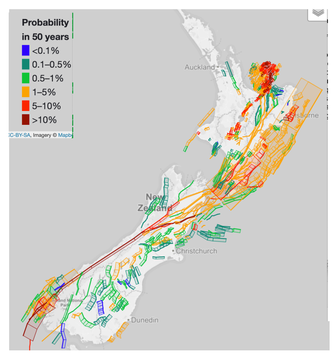
3. Simulation Atlas: https://atlas.seistech.nz

Faults in New Zealand and Potential Future Earthquakes

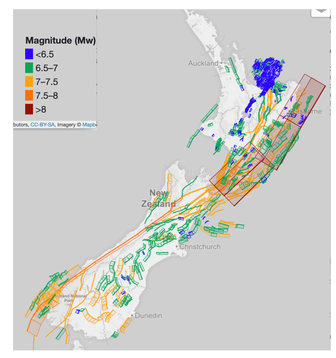
Simulation Atlas shows the location of major known faults from New Zealand's active fault database, which includes 536 fault sources (Stirling et al. 2012). The map of faults can be viewed with three different colour schemes based on tectonic type, magnitude of potential future earthquake, and probability in 50 years of such an event.



(a). Tectonic Type



(b). Probability of event occurring in 50 years

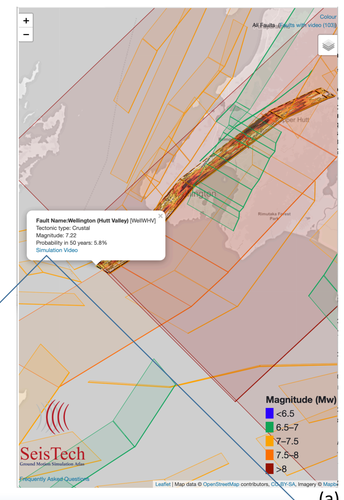


(c) Magnitude of potential future earthquakes

Figure 3 Major known faults in New Zealand.

Example: Faults near Wellington

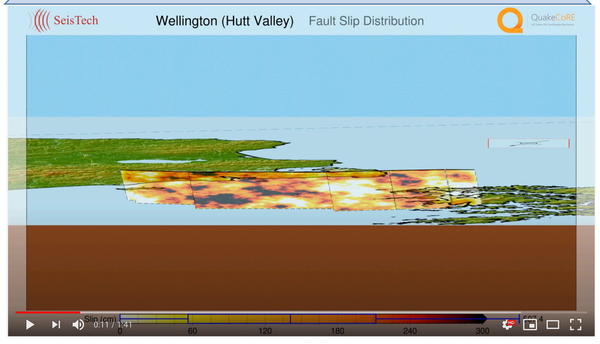
The user interface is intuitive, and allows users to navigate and zoom in to the regions of interests.
When a fault (represented as a chain of planes) is selected, brief information of the fault is presented, and the fault slip distribution is overlaid on the planes. This is a representation of the kinematic ruptures modelled using Graves and Pitarka 2015 method that considers fault geometry, moment magnitude, rake angle and hypocentre location.
If the fault has a 3D animation available, a link to the video hosted on Youtube (http://www.youtube.com) is provided. Currently, animations of 110 faults have been produced, and the list is growing. We use GMSimViz (Polak et al. 2019), an in-house-developed automation tool, to convert the ground motion simulation output into a 3D animation. GMSimViz takes the low-frequency (<1Hz) portion of Ground motion simulation based on Graves and Pitarka approach computed with 100m grid spacing.



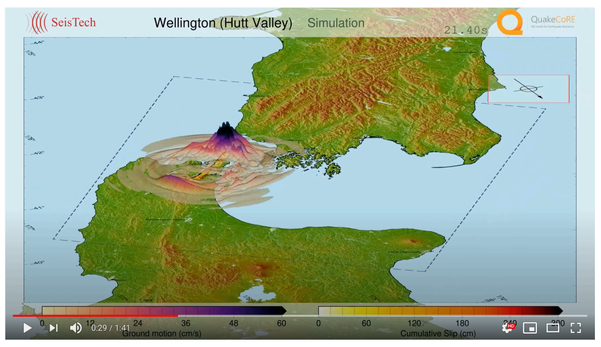
(a).

The 3D video produced by GMSimViz begins with a bird-eye view of the region and faut slip distribution on the fault planes, followed by the ground motion animation and peak ground velocity (PGV).

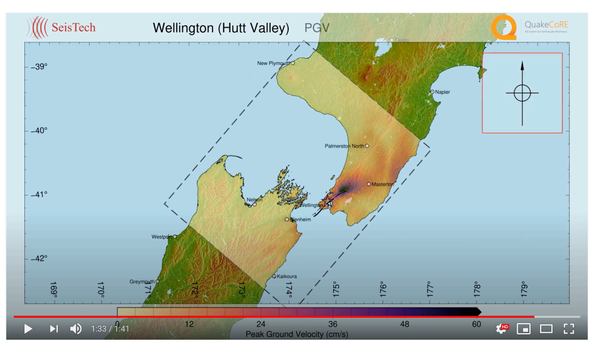
GMSimViz uses Generic Mapping Tools (GMT) to create individual frames, and join them by FFmpeg to create a movie file. It is designed to dynamically determine the camera angle and location following the movement



(b).



(c).



(d).

Figure 4 (a) Magnified view of Wellington (Hutt Valley) fault, and screen captures from GMSimViz animation for the fault. (a) Fault Slip (b) Ground Motion (c). PGV.

Historical Events

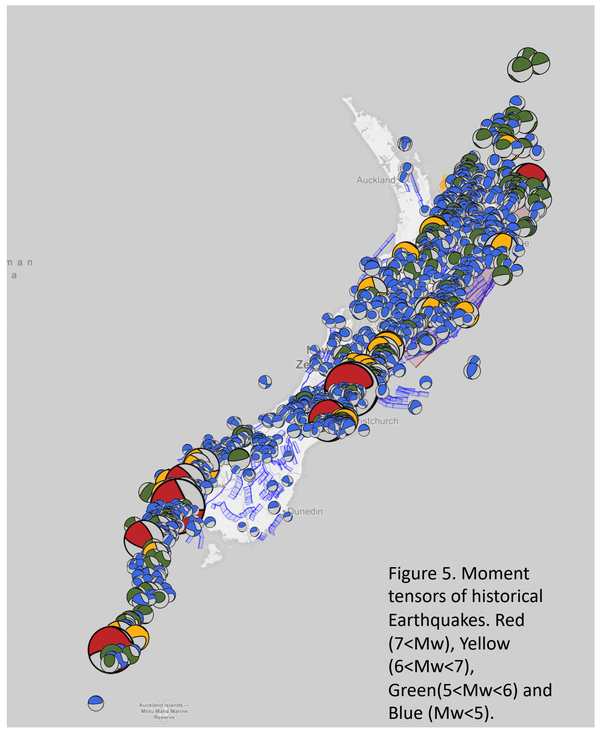


Figure 5. Moment tensors of historical Earthquakes. Red (7<Mw), Yellow (6<Mw<7), Green(5<Mw<6) and Blue (Mw<5).

The GeoNet earthquake catalogue is a comprehensive archive of technical information about historical earthquakes in New Zealand. Stored record includes public ID of the event, location, magnitude and arrival times of seismic waves. Based on this catalogue, Simulation Atlas provides the location of each historical event and its moment tensor.

Example: Mw. 7.8 Kaikoura Earthquake (Nov 13,

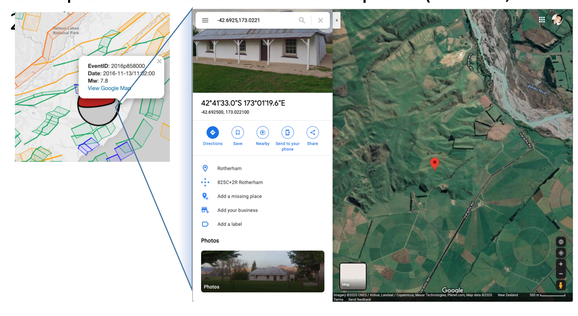


Figure 6 Magnified view of Mw 7.8 Kaikoura Earthquake (Nov 13, 2016). The link to the location of its hypocentre on GoogleMap is provided.